

SPACE EFFICIENT MULTI-USE EXERCISE APPARATUS

- [01] This application claims the benefit of prior co-pending provisional application Serial No. 60/256,473, filed December 20, 2000.

FIELD OF THE INVENTIONS

- [02] The present inventions relate to multi-purpose exercise equipment, wherein a number of different exercises are performable with different components of an integrated structure.
- [03] More specifically, the present inventions comprise a number of improvements and additions to the compactly stowable exercise apparatus described in U.S. Patent 5,725,459 (which is hereby incorporated by reference in its entirety). These improvements provide significant space utilization and aesthetic benefits, and/or offer additional exercises and improved ease of use.

BACKGROUND OF THE INVENTIONS

- [04] U.S. Patent No. 5,725,459 (the '459 patent) discloses a multi-purpose, compactly stowable exercise apparatus that can be free standing or wall mounted. Figs. 1 and 2 illustrate a first exercise machine embodiment 1 of the '459 patent, including a free standing generally L-shaped frame 3 comprising sets of upper rails 5A, 5B and lower rails 7A, 7B, mounting a pair of exercise resistance units 9A, 9B for movement toward and away from each other in intersecting planes, e.g., 90°, as shown. Figs. 3-5 show a second embodiment, wherein upper and lower wall mounted rails 5A', 7A', 5B', 7B' similarly movably mount resistance units 9A, 9B. In the illustrated embodiments, the exercise resistance units 9A, 9B are adjustable weight stack units providing independent sources of isotonic exercise resistance. The '459 patent discloses, however, that other types of exercise resistance could be provided, including progressive and isokinetic resistance, utilizing various known mechanisms.
- [05] Since weight stack units 9A, 9B are essentially identical, forming mirror images of each other, a description of one will suffice. Weight stack unit 9A includes a stack of

weight plates 11 operably connected through a block and tackle assembly with one end of a barbell 13. In particular, the block and tackle assembly comprises a flexible pull-line 15 (e.g., a cable) having an end portion equipped with a ring or other conventional connector member 16 releasably attachable to one end of barbell 13. A pull-position adjustment pulley block 17 is releasably attachable at different positions along a vertical guide beam 19, by a known aperture and locking pin arrangement, and serves to establish a vertically adjustable pull origination point, i.e. rest position for connector member 16. In order to maximize exercise versatility and freedom of movement, pulley block 17 is preferably mounted to pivot freely in the horizontal plane. With barbell 13 attached at its opposite ends to a connector member 16 of each weight stack unit 9A, 9B, the pull-position adjustment pulley blocks 17 serve to establish a vertically adjustable rest position of the barbell.

- [06] The inventive apparatus of the '459 patent is not limited to exercises with a barbell. A variety of exercise attachments, e.g., handles and bars, as are known in the art, may be attached to connectors 16. This allows numerous different exercises to be performed with the two weight stack units, individually and together.
- [07] Weight stack units 9A, 9B can move independently of one another on their respective pairs of upper and lower rails 5A, 7A, 5B, 7B (5A', 7A', 5B', 7B' as shown in Figs. 3-5). A locking arrangement is provided for allowing each weight stack unit to be conveniently releasably held, i.e., locked, in a desired position along the rails. The locking arrangement may comprise a series of spaced apertures in one or both of the upper and lower rail assemblies, and a locking mechanism on each weight stack unit comprising upper and/or lower pins that are selectively extensible into and retractable from the rail apertures. The capability to selectively lock each weight stack unit in different horizontal positions, coupled with the vertical adjustability afforded by adjustment pulley block 17, allows the pull-position, i.e., rest position of connector 16, of each weight stack unit to be moved substantially throughout a range of x-y coordinates within the boundaries of the respective upper and lower rails. Exemplary positions of the weight stack units 9A, 9B and corresponding adjustment pulley

blocks 17 are illustrated Fig. 2. This mobility provides a very high degree of versatility, allowing a wide range of different exercises and exercise variations to be performed (with one weight stack unit or both simultaneously).

- [08] In the free standing embodiment of Figs. 1 and 2, a locking mechanism is illustrated with a lower pin 35 for engaging apertures in lower rail 7A. In the wall mounted rail embodiment shown in Fig. 3, a modified locking mechanism has a lower pin 35 for engaging apertures in lower rail 7A', as well as an upper pin 37 for engaging apertures in upper rail 5A'. A two pin arrangement is generally preferred to provide additional stability and increased locking strength.
- [09] Referring now particularly to Figs. 4 and 5, it is seen how the wall mounted embodiment of the '459 patent can be installed in a corner area of a room, for highly space efficient use and storage. The set-up illustrated in Fig. 4 is for the performance of bench press exercises. Weight stack units 9A, 9B are spaced from the apex of the intersecting planes of their movement (i.e., the room corner). Barbell 13 is connected at its ends to respective pull-lines of weight stack units 9A, 9B, and a user support bench 81 is positioned therebelow. Bench 81 comprises a pair of articulated generally planar body support members 83, 85, and a pair of supporting legs 87, 89 attached thereto. Body support member 83 may be made movable to different inclined positions in order to allow for performance of inclined bench presses and other exercises.
- [10] In Fig. 5, barbell 13 has been disconnected from weight stack units 9A, 9B, bench 81 has been collapsed, and weight stack units 9A, 9B have been moved along the rails to positions adjacent each other and proximal the room corner. So positioned, a space 91 between the weight stack units and supporting framework (in this case, the walls) is created, and that space is utilized to store, upright, collapsed bench 81 and barbell 13. In addition, other exercise accessories, including other attachments to connectors 16, may be stored in space 91.

SUMMARY OF THE INVENTIONS

- [11] In view of the foregoing, it is a principal object of the present inventions to provide a number of improvements and additions to the exercise apparatus of the '459 patent, which provide significant space utilization and aesthetic benefits and/or offer additional exercises and improved ease of use.
- [12] In a first one of the inventions, an exercise apparatus includes a framework supporting two independent exercise resistance units and mounting the two exercise resistance units for movement toward and away from each other to respective use positions wherein the units are operable by a user in conjunction with each other to perform exercises, and to respective storage positions. Each of the exercise resistance units is movably mounted on a rail of the framework. The rail has a segment which is movable between an extended use position allowing a respective exercise resistance unit to move therealong, and a storage position reducing a footprint of the framework.
- [13] In a second one of the inventions, an exercise apparatus includes a framework supporting two independent exercise resistance units and mounting the two exercise resistance units for movement toward and away from each other to respective use positions wherein the units are operable by a user in conjunction with each other to perform exercises, and to respective storage positions. A cover panel is movably connected to the framework for movement between a closed position at least partially covering at least one of the exercise resistance units when the at least one exercise unit is in its storage position, and an open position exposing the at least one exercise resistance unit for use.
- [14] In a third one of the inventions, an exercise apparatus includes an adjustable exercise resistance structure. A pair of flexible line segments are operably connected to said exercise resistance structure. Each line segment has a respective end portion equipped with a connector adapted to be attached to a movable exercise member. The structure mounts the end portions such that they may be used in conjunction with each other to perform exercises. The exercise resistance structure supports the line

segments such that the respective end portions are maintained in respective vertically adjustable rest positions. Each line segment is extensible against a bias of exercise resistance provided by said structure, independently of the other line segment, to allow the respective end portion to move away from its rest position. Each line segment is independently retractable, by the bias, to return the end portion to its rest position. The apparatus further includes a barbell, and a pair of Smith guide columns and bearings attached adjacent respective adjustable mounts of said end portions. Each bearing is attachable to a line segment, and has a connector assembly for attachment of the barbell. The bearings are movable to positions permitting the barbell to be attached to, and to extend between, the respective connector assemblies. A starting position of the barbell is adjustable along the Smith guide columns by vertically adjusting the rest positions of the respective line segment end portions, and moving the bearings along the Smith guide columns.

- [15] ¹ In a fourth one of the inventions, an exercise resistance unit includes a flexible line segment operably connected to a source of exercise resistance and having an end portion equipped with a connector adapted to be attached to a movable exercise member. The exercise resistance unit supports the line segment such that the end portion thereto is maintained in a vertically adjustable rest position. The line segment is extensible against a bias of the source of exercise resistance to allow the end portion to move away from its rest position. The line segment is retractable, by the bias, to return the end portion to its rest position. The exercise resistance unit includes an adjustable weight stack unit and the line is provided as part of a block and tackle assembly of the adjustable weight stack unit. Each weight stack unit further comprises a vertically extending guide member, a plurality of weight plates slidably mounted on the guide member, and a weight attachment member attached at its upper end to said block and tackle assembly, and being selectively engageable with the weight plates, for selectively lifting a desired number of the weight plates along the guide member. The vertically extending guide member mounts a mechanism for reducing momentum of the lifted weight plates at the end of a lifting stroke, to thereby increase a retraction rate of the line segment.

- [16] In a fifth one of the inventions, an exercise apparatus includes a framework supporting two independent exercise resistance units and mounting the two exercise resistance units for movement toward and away from each other to respective positions wherein the units are operable by a user in conjunction with each other to perform exercises, and to respective storage positions. A treadmill is movably connected to the framework for movement between a storage position and a use position. Each of the exercise resistance units is movably mounted on a rail of the framework, and in the storage position the treadmill extends generally vertically adjacent the rail.
- [17] In a sixth one of the inventions, an exercise handle assembly includes an elongate handle. A flexible strap is connected to extend from opposite ends of the handle. A connector assembly is provided for connecting the flexible strap to a pull-line of an exercise resistance unit. When the strap is tensioned between the handle and the connector assembly, the handle remains generally freely rotatable through an arc residing generally in a plane of the tensioned strap, to thereby facilitate user forearm rotation.
- [18] The above and other objects, features and advantages of the present inventions will be readily apparent and fully understood from the following detailed description of the preferred embodiments, taken in connection with the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

- [19] Figure 1 is a perspective view showing a free standing exercise apparatus in accordance with the present inventors prior art U.S. Patent No. 5,725,459 (the '459 patent), including movable weight stack units with adjustable pull-position pulley blocks; the apparatus is shown set up and being used to perform bench press exercises.
- [20] Figure 2 is a perspective view of the apparatus of Fig. 1, with alternative use positions for the weight stack units and adjustment pulley blocks illustrated in phantom.

- [21] Figure 3 is a side elevational view of a weight stack unit of a wall mounted exercise apparatus in accordance with the prior art '459 patent.
- [22] Figure 4 is a diagrammatic top plan view of a prior art wall mounted exercise apparatus in accordance with the prior art '459 patent, set up for the performance of bench press exercises.
- [23] Figure 5 is a diagrammatic top plan view of the prior art apparatus of Fig. 4 in a stowage position.
- [24] Figure 6 is a perspective view illustrating an exercise apparatus in accordance with one of the inventions, enclosed by cover panels thereof.
- [25] Figure 7 is a perspective view illustrating the exercise apparatus of Fig. 6 in a bench press configuration.
- [26] Figure 8 is a perspective view illustrating the exercise apparatus of Fig. 6 in a leg extension configuration.
- [27] Figure 9 is a perspective view illustrating a setup of the apparatus of Fig. 6 for a vertical bench attachment.
- [28] Figure 10 is a perspective view illustrating a setup of the apparatus of Fig. 6 for a preacher curl attachment.
- [29] Figure 11 is a perspective view illustrating a setup of the apparatus of Fig. 6 for a treadmill option.
- [30] Figure 12 is a perspective view illustrating the exercise apparatus of Fig. 6 in a lat pull-down configuration.
- [31] Figure 13 is a detailed perspective view of a barbell connection to a Smith bearing in the apparatus of Fig. 6.

- [32] Figure 14 is a “see-through” perspective view illustrating an “ergo” handle in accordance with the invention.
- [33] Figure 14a is a perspective view of the “ergo” handle of Fig. 14, showing movement thereof.
- [34] Figure 15 is a perspective view illustrating a weight stack assembly including compression springs employed for functional training exercises, in accordance with one of the present inventions.
- [35] Figure 15a is a “see-through” perspective view of the weight stack assembly shown in Fig. 15.
- [36] Figure 16 is a perspective view illustrating the inventive exercise apparatus of Fig. 6 in a stowed-away condition with attachments, accessories and options (cover panels open, and weight stacks omitted for clarity).
- [37] Figure 17 is a perspective view of the exercise apparatus of Fig. 6 illustrating a setup for one arm rows.
- [38] Figure 18 is a perspective view illustrating a pair of like exercise apparatus secured together by a modular connector in accordance with one of the inventions.
- [39] Figure 18a is a close-up perspective view of the modular connector shown in Fig. 18.
- [40] Figure 19 is a close-up “see-through” perspective view illustrating extension rail pivot points.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Structural Frame

- [41] As seen in Figs. 6 and 7, the self-standing structural frame described in U.S. Patent No. 5,725,459 has been improved to reduce the amount of space required when the exercise apparatus is stored. Upper and lower rails have been broken into two parts -

stationary rails 101a-104a and extension rails 101b-104b so that the structural frame of the exercise apparatus can be enclosed within a smaller triangular structure comprising a corner column 104, a pair of tube columns 105a and 105b, a pair of upper stationary rails 101a and 102a, a pair of lower stationary rails 103a and 104a, an upper cross-beam 106 and a lower cross plate 107.

- [42] Since mechanisms to the left and right of the exercise apparatus are essentially identical, forming mirror images of each other, a description of one will suffice. Tube column 105a is attached to lower rail 103a by inserting it inside tubular end 108a provided at the apex of a triangular base 108 (see Fig. 12). Triangular base 108 is preferably provided in the shape of a deep triangular tray with tubular end 108a provided at one corner, and the side proximate to rail 103a being attached to rail 103a and cross plate 107 by a nut and bolt assembly going from triangular base 108 through rail 103a and plate 107a (part of cross plate 107). At its upper end, tube 105a is inserted into a tubular end 106a, part of the end structure of upper crossbeam 106, such respective end structure having a structure similar to that of triangular base 108. The upper housings for the left and right column ends preferably are provided as a unitary fabricated structure including upper crossbeam 106.

- [43] Extension rails 101b-104b may be of various types: collapsible, removable/re-attachable, telescoping, or even provided as a part of a pair of primary cover panels 109a and 109b. Upper extension rails 101b and 102b are an example of a collapsible type. Lower extension rails 103b and 104b are an example of a removable/re-attachable type. Top extension rail 102b is pivoted from a hanging vertical position at points 116 to its extended horizontal position by disengaging pin 110 (see Fig. 19) and pushing the free end of the extension rail up to a horizontal position where pin 110 can be reinserted into hole 111. The bottom extension rail 103b (see Figure 7) is positioned for use by sliding plate 103c (see Figure 16) into a slot or space formed by a tab 108b (see Figs. 6 and 16) of triangular base 108. In Fig. 16, the upper extension rail segment is shown hanging generally vertically, and bottom extension rail 103b is removed and resting generally vertically on top of stationary rail 103a.

Panels

[44] Moveable cover panels 109a and 109b (Fig. 6) have been added to the exercise apparatus of U.S. Patent No. 5,725,459 so that it can be enclosed, simulating a corner closet as shown in Figure 6. Panel 109b (with associated framework) is attached to tube column 105a through hinge plates 112 and 113. Tube column 105a thus serves as a hinge support permitting panel 109b to be pivoted into opened and closed positions by engaging handle 114. The outside of the cover panels 109a and 109b can have mirrors attached or decorative surface finishes, e.g., a wood finish, that can match the décor of the room where the machine is placed.

[45] Inner (secondary) panels 115 and 116 of the cover panels 109a and 109b (see Fig. 9) can be used to provide two additional features: 1) mirrors for users to check their posture while performing exercises and 2) informative postings, e.g., exercise illustrations and adjustment instructions per user height. Inner panel 115 is preferably about half the width of the outer (primary) panel, and provided with a separate centrally located hinge 117. Separate hinge 117 permits secondary panel 115 to be folded to one side to expose a mirror, and to the other side to expose informative postings.

Smith Ensemble

[46] The set-up illustrated in Figure 7 is for the performance of exercises with a removable barbell 118 connected to bearings 119 and 120 guided by linear guides 121 and 122. As shown, barbell 118 is usable to perform guided bench press, military press and squat exercises. In the industry, this setup of a barbell guided through a vertical linear movement is known as a "Smith" machine. A self-standing Smith machine is common among fitness facilities. In accordance with one of the present inventions, and in contrast to known arrangements, a Smith ensemble (barbell 118, Smith guides 121 and 122 and Smith bearings 119 and 120) is integrated within a setup of resistance units, such as the one described in U.S. Patent No. 5,725,459. The vertical guide column 123 for the pull-position adjustment pulley block 124 has been

displaced a few inches to one side in order to accommodate the Smith ensemble. Such integration increases the number of guided exercises possible with the described exercise apparatus, without limiting its ability to be enclosed within the structural frame above described.

- [47] Each Smith ensemble has also been equipped with a Smith safety support 125 so the user can quickly rest the weight lifted when he/she has reached momentarily muscle fatigue. This is done by engaging a Smith hook 126 (see Fig. 13) in slots 125a (see Fig. 7 - also provided at the opposite side). Hooks 126 are welded adjacent each end of the barbell such that the user may drop them into the slots of the Smith safety support 125 (Fig. 7) by rotating barbell 118. Plates 127 (Fig. 13) are rotatably secured at each end of the barbell 118 to allow rotation of the barbell on its own axis while the barbell is engaged with the Smith bearings by way of a spring loaded pin 134. The barbell 127 is removable by disengaging a spring loaded pin 134 from plate 127, whereupon the end of the barbell can be pivoted up and out of connector assembly 132.
- [48] The Smith guides 121 and 122 (Fig. 7) are preferably slightly slanted to imitate more closely the natural displacement of a barbell throughout the exercise movement when done with free weights.
- [49] As shown in Figure 7, the Smith guide 122 is attached to redesigned upper and lower structural housings 128 and 129 (top and bottom waists) of each moveable resistance unit (e.g., weight stack), and U-shaped guide member 130, serving as mounting locations for the Smith guide. Each Smith guide has a bearing to which the line offering the resistance, i.e. cable 131, is attached with connectors of conventional design. Each bearing is counterbalanced in a known manner by attaching to it a line segment that extends upwardly to a small top pulley and then downwardly to a counterweight 119a (see Fig. 11) which is guided by its own vertical guide (not shown). Such a vertical guide is attached to the lower structural housing 128 and at the top to the upper structural housing 129. Counterbalanced bearings are standard in

the industry, and are provided particularly for those users that would not be able to lift the total weight of the bearings and Smith bar without any additional resistance.

- [50] Bearing connector assembly 132 (see Fig. 13) has several positions for fine height adjustments of the barbell. Macro adjustments of the starting position for the Smith bearings are achieved using holes 133 of pulley column 123 (see Fig. 7). The objective is for the user to be able to make smaller adjustments to better position the height of the barbell at an appropriate starting height. As an example, for bench press exercises the user will make a macro adjustment of the barbell height by selecting the height of the pull-position adjustment pulley block 124, and then make fine adjustments of barbell height by selecting the position of the spring-loaded pin 134 (Fig. 13) of connector assembly 132.

Folding Bench

- [51] As seen in Figs. 8-11, the folding bench described in U.S. patent 5,725,459 has been re-designed to collapse (see Fig. 11) more tightly and easier against corner column 104, and to provide easier setup for moving from exercise to exercise. Its horizontal structural support 135 is a telescoping lever anchored to corner column 104 by a pin 136 selectively positioned in holes (not shown) provided inside a generally "H" shaped cross-section of corner column 104. This telescoping lever maintains the bench in a centered bisecting plane of the exercise apparatus, so users only have to move the bench towards or away from the corner and engage/disengage pin 136a (see Figs. 7 and 8) and not worry about the bench being properly positioned to provide an equally distanced engagement of handles attached to each weight stack unit. In addition, horizontal bench support 135 provides guidance to fold the bench upright into a stowage position against corner column 104, as shown in Fig. 11. A "U"-shaped bench support 137 (Fig. 7) is collapsible against the backside of the seat support, as shown in Figure 11.
- [52] A pair of rollers 138 and pulleys 139 (see Fig. 7) have been added at the lower part of bench support 137. Spring-loaded rollers can be used to lift support 137 from contact

with the ground, to thereby help the user easily move the bench to a desired position when he/she is not seated on it. The two pulleys provide guidance for the lowest possible starting position of a handle 140 (see Fig. 17) connected through a cable 141 and connector 142 to the weight stacks.

Lat Pull-Down Pulleys

- [53] The upper cross beam 106 includes a pair of lat pull-down pulleys 142 (see Fig. 12) placed at its center, each with a separate cable 143. A cable end connector 144 is maintained below center pull-down pulleys 142 as the cable extends over the lat pull-down pulley 142 toward pulley 145 (hidden) and, when not in use, it may be stored extended around pulley 145 to a storage hook positioned at 146 (hidden). The lat pull-down pulleys 142 are set within a housing 106c that allows the pulleys to pivot toward or away from the corner.

Vertical Bench

- [54] A vertical bench attachment, shown in Figure 9, is used for exercises such as vertical knee raises and dips. A structural beam 146 attaches a hinged back support 147, two arm supports 148, two hinged tube handles 149 and upper and lower diagonal supports 150, 151. The vertical bench 180 stores hanging flat from a stretching bar 152, as shown in Fig. 16 (bar 52 seen also in Fig. 7). For use, the user places both of the movable resistance units in a vertical bench position, as shown in Figure 9. The upper and lower diagonal supports 150, 151 of the vertical bench are placed in slots 125a (see Fig. 7) of Smith safety column 125 at a desired height. For doing vertical knee raises, the tube handles 149 are locked in a vertical position as shown in Fig. 9, and for dips they are locked in a horizontal position by a disengaging pin 152a.

Preacher Curl

- [55] A preacher curl attachment, as shown in Figure 10, can be placed in a connector 153 (see Fig. 8). A support pad 154 of the preacher curl attachment has at least two different positions, inclined and flat, that are selected by selectively engaging a pin

(not shown) at 155. Height adjustments are also possible by selectively engaging a pin (not visible) at 156. In Fig. 16, the preacher curl attachment 181 is shown in a stowed-away position.

Leg Extension and Leg Curl Attachment

- [56] This attachment is improved over the one described in U.S. Patent No. 5,725,459 in that each set of ankle pads 157 and 158 (see Fig. 8) can be removed, turned 90 degrees, and reattached so it can be stored behind the plane of movement of the resistance unit, as seen in Fig. 16 (attachment labeled 158a).

Treadmill

- [57] A folding electric treadmill 159 (see Fig. 11) has been added to the exercise apparatus described in U.S. Patent No. 5,725,459. Electric treadmills are well known in the industry, so a description is only provided for the novel features related to folding the treadmill very tightly behind the moving plane of the resistance unit (to position 160 shown in Fig. 16). The main structural housing 161 (see Fig. 11) holding the motor and frame of the treadmill rests on the floor and is attached to the outer side of the bottom rail 103a (see Fig. 6) and triangular base 108 (see Fig. 12). The pivot axis of the treadmill is preferably aligned with the rotational axis of the drive motor. The treadmill drive motor is preferably controlled by way of an electronic console 162 that also controls the inclination of the treadmill. The power and data cables (not shown) connecting the motor with the electronic console may be conveniently run inside tube column 105a (see Fig. 6). The electronic console 162 hangs from the top rail 101b as shown, and it is pulled down from its stored position 163 (see Fig. 16) to a comfortable eye level as the user stands on the running belt. The electronic console provides selective exercise programs, a heart rate monitor, and other electronic features common to treadmills. In addition, the screen monitor could be connected to be used as a TV and to surf the Internet. A handrail 164 of the treadmill is preferably made of two parts that are also foldable upright along with the treadmill.

Functional Training

- [58] Functional training is beneficial for sport and lifestyle body movements done repeatedly with considerable speed, i.e. punches and kicks. It requires that the momentum of the weight stacks be significantly reduced in order for the weight stack cable to retract instantly for a next repetition. To permit this action, guiding rods 165 (see Fig. 15) for weight stack 166 are made hollow. A compression spring 167 is placed inside each guide above the weight stack. Grooves 168 at each side of the guides provide clearance for engaging a removable key 169. These grooves start from a height where the key rests and extend to a maximum height allowable by compression of spring.

Ergo Handles

- [59] Handles as shown in Figure 14 are designed to allow freedom of movement on wrist acceleration/deceleration 170 and forearm clockwise/counter-clockwise rotation 171. The objective is to reduce stress in the wrists during exercises by allowing the wrist and forearm to freely rotate at their main axis of rotation. Accelerations and decelerations are made possible by the handle being configured as a tube 172 that rotates on the outside of an inner cylindrical housing holding a set of rollers 173. Forearm rotation is provided by having a strap 174 extending inside the inner housing of the handle through the set of rollers 173. (It will be understood that "strap" as used herein encompasses not only a flat strap as illustrated, but also various other types of strapping, including cable, rope and other types of line.) The rollers serve to facilitate the handle's clockwise or counterclockwise travel along the strap, which forms a closed loop connected through an eyelet 175 to a connector 176. As depicted by the arrows in Fig. 14a, the handle slides along the strap, facilitated by the rollers inside the handle and extending to the opposite outsides. Thus, when the strap is tensioned between the handle and the exemplary connector assembly formed by eyelet 175 and connector 176, the handle is generally freely rotatable through an arc residing generally in a plane of the tensioned strap. The handle also rotates on its own longitudinal axis.

Stretching Bar

- [60] An adjustable stretching bar 152 (see Fig. 7) is attached to plate 177 and corner column 4. The attachment in the corner column is vertically adjustable by positioning pin 178 in a selected one of holes 179.

Modular Connector

- [61] One or more modular connectors 182 (see Figs. 18 and 18a) may be used to securely attach one structural frame to another like frame by their respective tube columns 105a and 105b. Preferably, the adjacent frames (systems) are connected adjacent both their upper and lower rails, between the panel hinge plates 112 and 113 (see Fig. 6). This arrangement provides additional structural integrity and stability when plural systems are employed, e.g., as shown in Fig. 18.
- [62] The present inventions have been described in terms of preferred and exemplary embodiments thereof. Other embodiments, features and variations within the scope and spirit of the inventions as defined in the appended claims will occur to persons of ordinary skill in the art from a review of this disclosure.